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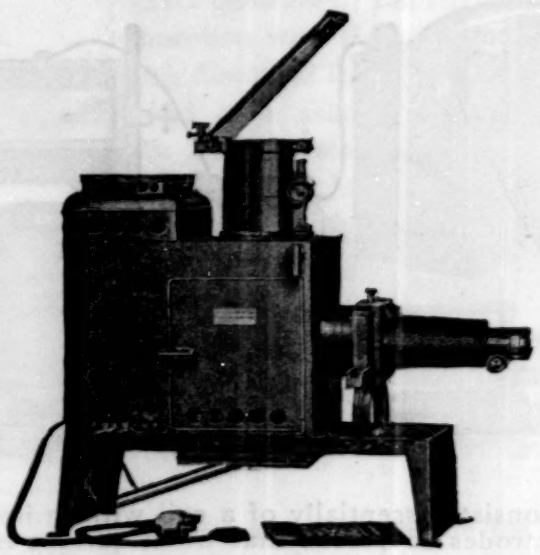

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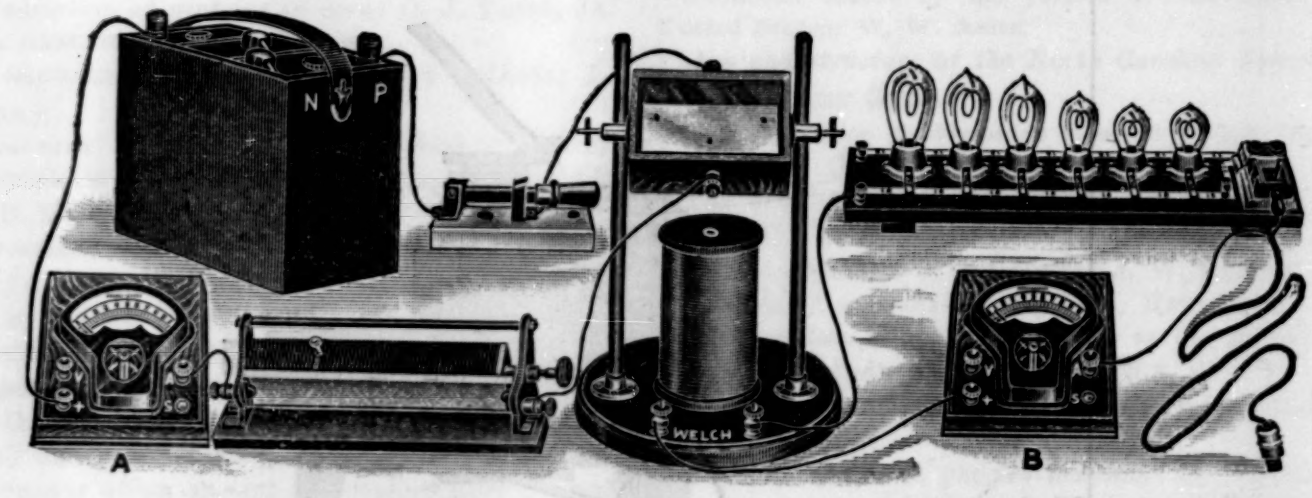

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SCIENCE

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE ADMINISTRATION OF AGRICULTURAL RESEARCH[1]

THE question of the advantage of administration in connection with the prosecution of research has been much discussed in academic circles. It has often been looked upon askance in that quarter, and there has been apprehension lest the attempt to organize for research should infringe upon that freedom to investigate which is conceived to be the birthright of every pioneer research worker. President Angell referred to this in an address before this Association a few years ago when he said: "A fairly prevalent conception of research associates it with the somewhat mystical intellectual operations of the genius or 'near genius,' to tamper with which is a kind of profanation."

Such a view is based on the academic or university conception of research and relates, doubtless, to the more abstract field of inquiry in which the individual follows out his own course in the pursuit of that elusive thing, an idea. But much research at the present time is not of that personal or essentially individual type, carried out for the gratification and advancement of scholarship of the principal; it is institutional in that it is conducted by individuals associated in groups. They may work independently or in varying measure of cooperation, but they are members of an organized agency, designed to serve a particular field or purpose. Such agencies are developing rapidly. They deal quite largely with industrial or applied research, since their ultimate purpose is to solve problems or acquire information for the more immediate benefit of an industry or the public generally.

Agricultural research—using the term broadly—is the largest example of this type, and it is almost wholly supported or subsidized by public contributions. Practically all of it is organized, carried on by units constituted for the purpose by law; and, being organized, there must be administration by a responsible head. For organization and administration are twin brothers, in research as well as in industry. This condition does not interfere with the opportunity of the individual—it often contributes to it; but it does affect his relationships, and it imposes responsibility which the independent investigator does not accept.

[1] Paper presented at the Chicago convention of the Association of Land-Grant Colleges, November 14, 1923.

Of course, it is possible for administration to go too far, to be arbitrary and unreasonable, to exceed its function; but that is not the tendency at present in our agricultural institutions. Rather it may not go far enough in some cases.

A research institution is a public trust. It carries a very definite obligation, to humanity and civilization. Research is one field in which responsibility for the use made of opportunity and resources can not be shunned. It is not a private affair. It is a matter of public concern wherever it is done, for it is the means of growth of civilization and human welfare.

Perhaps the primary function of administration may be defined as making the most of the resources at hand, to the highest advantage of the field designed to be served. If it is true to those dependent upon it, it should aim to secure the maximum output for the funds used, to express the fullest use of the facilities at hand, the largest practicable return for the investment. "It is not the money itself but the skill and intelligence with which it is applied that determines the amount of service rendered." This is the business side. It is the principle of good business understandingly applied to research, but it is as different from the administration of business as research is from industry or commercial life. The attainment of success and the measure of it require scientific as well as business judgment.

The fundamental principle of administration in research has frequently been stated in the simple terms of selecting good men and giving them freedom and sustained support. To me, it is emphatically this, but something more—certainly more than a passive attitude toward their work after the group has been assembled. It implies an attitude of continued interest, of sympathy, understanding and encouragement; and it also implies expectation. The latter may show itself in a close study of the progress of the work and its competence to attain the ends sought, a questioning of whether delay or failure is due to the worker, his methods or his environment. It may lead to counsel and suggestion, or even to restraint, for the continued support of projects will usually bear relation to the degree with which expectations are being met. Even the most abstract research looks toward the completion of its project, and does not carry with it unlimited freedom to follow at random wherever interest or inclination may lead. A spirit of friendly criticism, of expectancy and the weighing of prospects, is an attribute of the keen administrator, although it may rarely come to the surface.

In such an organization as an experiment station, the selection of a working program out of the multitude of things which might be undertaken is naturally one of the large functions of administration. Otherwise, as usual, what is everybody's business is nobody's business. Someone must familiarize himself with the leading agricultural questions of the State or region, and maintain contacts with the industry as a whole. This usually centers in the director, for, although he needs the counsel of his specialists, in the last analysis he will be called upon to decide upon and to assume responsibility for the way in which the station is discharging its mission.

Theoretically the working program is a general expression of what most needs to be done to meet local needs or to advance problems of wider range. Naturally it deserves to be well studied and properly balanced. In this an advisory committee may be of much help.

It usually happens at the present time that this program is in part inherited and can only be reshaped gradually, but it is for the director to size up the various features of it, determine their adequacy and relative importance, and work out a policy for further development. For such a research institution must be constantly going forward.

One of the most difficult tasks of administration is the selection and recruiting of the staff. This is one of its largest responsibilities, so much depends upon it. It is naturally governed by the lines to be emphasized, and within these it depends on disposition to search out men and ability to judge them. The choice may be influenced by the fact that other college duties are to be involved, but even when this is the case, the representations of the director as to the necessary qualifications for research may have much weight.

It is sometimes said that the efficiency of an experiment station is the sum of the efficiency of its staff, to which should be added, in my judgment, judicious administration, for even with a highly competent staff the effectiveness with which their work is carried on will depend to no small extent upon conditions which center in the administrative office.

The fact that over half the workers in the experiment stations have other calls upon them—either teaching, extension, regulatory or service—gives opportunity for administrative attention. In a sense research has often to meet the competition of other college duties and interests, some of which are regular and imperative. Hence the necessity for insuring to the workers the necessary time for research, and avoidance of the frequent tendency of individuals to take on too many different projects. This latter needs to be guarded or it may result in good intentions degenerating into protracted routine with too little study. Opportunity is required, not only for the making of experiments, but for the exercise of the thinking function indispensable to research.

Furthermore, individual workers vary in their qualifications and experience, and they are grouped in college departments in which the research spirit

often varies. The wide range of station work, from routine determinations and observations, and the making of relatively simple tests and experiments, to the more original abstract and theoretical inquiry, affects the standards and the outlook of workers. The director may help to correct this in individual cases, and give opportunity for growth. He may supply incentive which will encourage workers to strengthen their attack and look deeper into their problems. Administration can not put into a man what is not in him, but it can stimulate his development, if the basis is there, and it may lead and help him to make better preparation and to elevate his standards. It may give him a chance, and impress upon him both his opportunity and his responsibility.

Similarly the standards and type of work of different departments may call for attention. For while departments can not expect to be self-contained it is now very evident that the fundamental research can not be done in one place or department and the applied work in another. Departments themselves may need to be strengthened. Certain ones will usually stand out more prominently in their work than others, for a symmetrical organization is rarely attainable, but the research spirit should be in evidence, with encouragement for its development as opportunity offers. Without a well-defined research policy, competent workers can not be attracted to a department; and on the other hand, ambitious investigators whose efforts are not sympathetically supported will seek other fields or lose their zeal.

In practise, administrative attention is usually needed in some directions more than in others. Different men work according to their particular aptitudes and habits. Research in the more abstract fields can not be systematized to the extent that less exacting types may be, and in large measure the investigator in that field must be free to follow his vision. Not infrequently, however, well qualified investigators respond to suggestion which directs them into channels germane to the station and the special subjects it desires to study, or prevents their wandering too far afield. Naturally, the director should come to know his men, for in a sense the freedom accorded an investigator usually will be earned.

It has been said of one of our most successful station directors, recently retired, that he performed "the difficult and delicate task of administering research in such a way as to enable his associates to put forth their best." This is one of the highest tributes that could be paid such an officer, for as another has said, "the chief problem of the research director is to maintain the freshness of view, enthusiasm and keenness of his staff."

Again, administration may insure that each undertaking is well considered at the outset, that so far as feasible it has been thought through, that its real nature and what it will likely involve have been gone into, and that if insufficient in itself it may have the support of workers in other lines. If administration does this it will lend real service, to the investigator as well as to his organization.

It is now generally conceded that owing to the complex character of problems in agriculture there is a substantial basis for cooperation. Rarely are departments sufficiently broad or complete in themselves to solve these problems in a thorough way, or to make the contributions applicable unless they are supported by the studies of other branches. The drift toward specialization emphasizes this and calls for correlation of effort and of forces. The attitude of the director can do much to develop the cooperative spirit and effect union of effort where needed.

This may seem a large program for the administrative officer. It implies that his heart and understanding are in research, and it involves the maintenance of close contacts. But the duties connected with administration do not necessarily all devolve in detail upon the administrative head. Especially in the larger stations he may so organize these as to bring to his aid committees and councils of various kinds, and supply means for keeping himself informed. These constitute the machinery of administration, and they have been found decidedly helpful in many cases. They may promote alike the spirit of unity and of individual responsibility, and cement the feeling of partnership in the carrying out of a great enterprise.

What then of the qualities of an administrative officer to discharge the functions of his important office? According to the Report of the Commission on Agricultural Research, made to this Association in 1907, "The immediate executive officer of a research agency should be a broadly trained scientist . . . whose time and thought should not be seriously absorbed by other duties. Such expert direction is essential to securing proper unity of work and the efficient coordination of the efforts of individuals." The same idea was recently expressed by the staff of a station where the position is vacant, in maintaining that the director "should be a man who through first-hand experience understands the methods and purposes of modern agricultural experiment."

To quote from a leading English authority on the subject:[2]

> The director of a research organization requires not only the qualities of a research worker, but those of an administrator. Scientific training of a high order should be combined with considerable practical experience in the industry concerned. . . . He must have a wide knowledge of men, be tactful in handling them, and able

[2] Fleming and Pearce, *Research in Industry*.

to inspire them with enthusiasm he himself must feel. He must be primarily a leader. In no way will his capacity be more demonstrated than in the manner in which he attracts and retains the services of able men.

Evidently the director of a station can not hope to be an expert in all the parts of the station's work, but he can know something about them and the elements essential to their success. In the more conventional lines of experiment, which comprise a very considerable part of the station work, he may claim some judgment regarding their competence to advance beyond a certain point, and their need for supplementing by more exact inquiry. Even in the more advanced lines, it is possible for an officer trained in science to determine whether the investigation is definitely aimed and keeping to its course, whether it is constantly constructive and not falling into an unstudied routine.

It is apparent, therefore, that the administrative officer ought not to lack for time, for his duties to his staff and to the public, the weighing and evaluation of efforts, and the maintenance of the work upon a plane adequate to the needs, will make no small demands upon him. There is danger in such an officer having too many other duties and outside interests which tax his strength and divert his attention, sometimes for protracted periods. He ought himself to be a student, with opportunity for the full play of his vision of problems and possibilities and the means of meeting them. His chief task will be to maintain the objective of the station in the largest and best sense.

This may well be his first concern at all times. A fund of a hundred thousand dollars and upwards for research, such as over half the stations enjoy, amounting to more than a quarter of a million in ten States, is no small responsibility and gives opportunity for the best thought and judgment at command. It opens the way for the highest type of administration. It calls above all for that inspirational leadership which serves to spread the "contagion of ideas."

E. W. ALLEN
U. S. DEPARTMENT OF AGRICULTURE

RESOLUTIONS ADOPTED AT THE AUSTRALIAN MEETING OF THE PACIFIC SCIENCE CONGRESS

THE scientific problems of the Pacific are so numerous and varied and involve so many individuals, institutions and governments that it has been found profitable to organize conferences at which work in progress may be discussed and means and methods for further progress may be carefully considered. The probable value of such conferences was recognized by the Australian meeting of the British Association for the Advancement of Science, 1914. A conference on the Pacific, which included in its program science, history and international relations, was a feature of the Panama-Pacific Exposition at San Francisco in 1915; at the semi-centennial anniversary of the University of California in 1918 a similar conference was arranged; and the Exploration of the Pacific formed the central theme at the meeting of the Pacific Division of the American Association for the Advancement of Science in 1919.

The consideration of this subject by the National Academy of Science resulted in the establishment of the Committee on Pacific Exploration in 1915—a committee which, with changes of personnel, has become the Committee on Pacific Investigations of the National Research Council. The deliberation of this committee showed the advantages to be gained by a series of conferences which would bring together representative scientists from Pacific countries actively engaged in research. During the period of the war the scope and purpose of such conferences were discussed on the basis of extensive correspondence and in 1918–19 meetings of the Committee on Pacific Investigations resulted in arrangements for the conference which met in Honolulu, August 2–20, 1920.[1]

The Pan-Pacific Science Congress held this year in Australia had the same general function as the Honolulu conference, but was wider in scope and had a larger attendance. Its proceedings are to be published by the Australian National Research Council under whose auspices the Congress convened. By invitation of the Japanese National Research Council the Congress of 1926 will be held at Tokyo.

The scope of the Australian Congress, which was attended by delegates from Australia, British Malaya, Canada, Chile, Dutch East Indies, England, Fiji, Formosa, France, Hawaii, Holland, Hongkong, Japan, New Guinea, New Zealand, Papua, the Philippines, Scotland, Tahiti, United States, is shown by the resolutions adopted.

In selecting the resolutions for publication those primarily of local interest have been omitted, and from certain others explanatory clauses have been eliminated. The Australian Research Council has authority to revise the wording of resolutions before publication in the official proceedings of the Congress.

ORGANIZATION AND FUTURE MEETINGS

(1) That this Congress recommends the establishment of a permanent organization of the scientific institutions and individuals engaged in research on the scientific problems of the Pacific Region.

(2) That the President of the Third Pan-Pacific Sci-

[1] Proceedings of the First Pan-Pacific Scientific Conference, Bernice P. Bishop Museum Special Publication, No. 7, Parts I, II, III, 1921.

ence Congress request the National Research Council or similar institution or agency of each of the following countries, *viz.*, Australia, Canada, Chile, France, Great Britain, Japan, Netherlands, New Zealand, the Philippine Islands and the United States of America, to appoint a member of an Organization Committee, the chairman of the Committee to be a resident of the country in which the Congress will be held, and that the Committee be empowered to add to its membership representatives from other Pacific countries.

(3) That the Organization Committee be requested to prepare a preliminary draft of a constitution and methods of procedure of the organization and to report its recommendations to the next Congress.

(4) That the National Research Council or equivalent organization of the country in which the next Pan-Pacific Science Congress is to be held be invited to appoint the President and other executive officers of the Third Pan-Pacific Science Congress and that all the executive duties in connection with that Congress be entrusted to it.

(5) That this Congress requests the Australian National Research Council to take any steps necessary to give effect to any resolutions of which Congress approves.

SECTION I. AGRICULTURE

(1) The Congress approves the appointment of a special committee consisting of five geneticists to collect information on all genetic research, now in progress in the countries bordering on the Pacific Ocean; this committee to report to the next meeting of the Congress.

(2) This Congress, realizing the great economic importance of properly conducted soil surveys, recommends to the Governments of the Pacific region that such work be pushed ahead as rapidly as possible, that the physical character of the soil and subsoil be the basis of such surveys, and that, when practicable, the character of the native flora growing on each type of soil be recorded.

(3) (Joint Recommendation from Agriculture, Entomology and Forestry Sections.) That in view of the destructive nature of several diseases of sugar-cane, introduced into Australia from New Guinea, and the possibility that the cultivation of sugar-cane in the tropics originated in that area, the Congress recommends that a survey of the diseases and insect pests of sugar-cane and their natural means of control be undertaken in New Guinea at an early date, by the Pacific countries interested in sugar-cane cultivation.

(4) Since plant diseases and insect pests cause enormous aggregate losses of crop plants, the Congress recommends: (1) That their distribution be limited as much as possible by plant quarantines; (2) That plant disease and insect pest surveys and epidemiological studies, which are prerequisite to intelligent action, be undertaken in all countries bordering on the Pacific; (3) That the results be interchanged freely.

SECTION II. ANTHROPOLOGY AND ETHNOLOGY

(1) Teaching of anthropology: The preservation, progress and welfare of the native population of Oceania, which is a charge under the terms of the Mandates granted to the Commonwealth of Australia, can best be carried out by a policy based on the investigation of native conditions, customs, laws, religion and the like, which is a study not merely of academic interest and importance, but points the way to a sympathetic method of dealing with and governing such peoples. The economic development of these countries depends largely upon the adoption of an intelligent native labor policy of recruiting, treatment, protection, and so forth, which can be built up only on a wide and sympathetic knowledge of native life and thought; this knowledge can best be gained only by intensive investigations by trained students.

The Congress, therefore, suggests that provision be made for the teaching of anthropology in the universities of Australia.

(2) Need for research in Australia and Oceania: Recognizing the necessity for the immediate prosecution of anthropological research in Australia and Oceania, this Congress calls the attention of governments, universities, patrons of research and research foundations to the pressing and important need for this investigation.

The undoubted disappearance of the native population in many areas, which not only seriously affects the labor problem, but involves the loss of most valuable scientific material, and in the territories held under mandate, is itself the most serious obstacle to the duty accepted by the mandatory powers of promoting the material and moral well-being and social progress of the inhabitants.

It is therefore urged that governments responsible for the welfare of Oceanic peoples should recognize that ethnology has a practical value in administration and is of definite economic importance, and that they should proceed without unavoidable delay to take such steps as are necessary for these purposes.

In view of the great and peculiar interest of the Australian aboriginals as representing one of the lowest types of culture available for study, of the rapid and inevitable diminution in their numbers, and of the loss of their primitive beliefs and customs when under the influence of a higher culture, the Pan-Pacific Congress urges that steps should be taken, without delay, to organize the study of those tribes that are, as yet, comparatively uninfluenced by contact with civilization.

(3) Objects of Research: The study of racial mixture is of great importance from a sociological point of view, but it is first necessary that the physical anthropology and psychology of the component races should be adequately investigated. An agreement as to procedure and standardized methods should be adopted without delay, as without these, comparisons of results by various workers are impossible.

The intensive study of limited areas, comprising all branches of anthropology, including linguistics.

The collection, translation and publication of information already on record.

One object of these and similar inquiries is to elucidate the history of Oceania, which can be accomplished by a comparative study of traditional lore, languages, beliefs and practices, and physical characters.

It is essential that anthropologists should seek the

cooperation of geologists, botanists and zoologists, since the solution of the problems of the distribution of men is largely dependent upon their aid.

For historical reasons the area that first needs study is Micronesia, since the culture and ruins of this group are of such a nature that, adequately dealt with, they should furnish the clue to much that is obscure in Oceanic mythology, folk-lore and culture generally. While Micronesia is an area of outstanding importance, other parts of Oceania should receive early attention, among them being Southern Melanesia, including New Caledonia, New Guinea, Tahiti and neighborhood, especially Raiatea, and Manu'a of Samoa.

(4) Areas of Research: The Congress is generally agreed that it is desirable for practical purposes that the investigation of various areas in Oceania should be undertaken as a whole by definite bodies.

The Pacific region may be divided into four main areas—(1) Australia, (2) New Guinea and Melanesia, (3) Polynesia, (4) Micronesia.

It is suggested: (1) That Australian ethnology be the special concern of Australia; (2) that Australia should more particularly investigate Papua, the mandated territory of New Guinea and Melanesia, but Great Britain and France should assist in this work; (3) that the investigation of the Maoris be the especial province of New Zealand (the rest of Polynesia may be regarded as preeminently the field for American research, with the cooperation of France and New Zealand); (4) that the study of Micronesia be the particular province of Japan and America.

Although Indonesia is not technically a part of the Pacific it has such close historical and cultural affinities with Oceania that a thorough investigation of this area is indispensable for a comprehensive knowledge of Oceanic problems. While recognizing what has been done by the Netherlands Indies Government the Congress hopes that this government may see its way to cooperate in the proposed scheme.

SECTION III. BOTANY

(1) It seems desirable that a complete botanical survey be made of Macquarie Island in order to obtain records of plant distribution and migration of Antarctic flora.

(2) It seems desirable that a complete botanical survey be made of the Aleutian Islands that records may be obtained of plant distribution and migration of the Arctic flora.

(3) It is recommended that the botanical surveys made of Krakatau Island be continued.

(4) It is recommended that between Congresses there be an exchange of botanical research work bearing upon the Pacific.

(5) It is recommended that museums, herbaria and research laboratories establish a system of exchange of research material bearing upon the Pacific.

(6) It is recommended that ethnological, geological and other expeditions, so far as possible, might be provided for the collection of botanical material.

(7) There is an urgent need of a bibliography of the botany of the Pacific Islands.

(8) That it be suggested to the state government of Victoria that it should reserve for all time an area or areas of land on which the tallest eucalypts now living have their stand.

(9) In view of the need for detailed information regarding native plants, it is recommended that the various herbaria and collectors be asked to use field labels similar to those used in the Philippine Islands and Dutch East Indies.

SECTION IV. ENTOMOLOGY

(1) That, in view of the danger to Australian industries from insect pests, indigenous and imported, this Congress is of the opinion that the Federal Government should set aside adequate funds for the establishment, equipment and maintenance of a Federal Bureau of Entomology for the necessary research in this connection.

(2) That the Congress urges the importance of making special provision for training in our universities economic entomologists up to the highest standard of proficiency.

SECTION V. FORESTRY

(1) That it be suggested to the Commonwealth Government to extend the scope and activities of the Institute of Science and Industry by the establishment and maintenance of an efficiently equipped Forest Products Laboratory.

(2) Having regard to the limited extent of forested land, and the prospects of a large increase in population, the importance of permanently reserving for forestry all suitable timber-bearing areas in the Commonwealth of Australia is suggested in the interests of national safety.

(3) Having regard to the approaching world's shortage of coniferous woods, it behooves all Pan-Pacific countries to give immediate attention to the subject of planting, and that this resolution be brought to the attention of the federal and state governments of the Australian Commonwealth.

SECTION VI. GEODESY AND GEOPHYSICS

(1) It is desirable that maps of Australia should be prepared on the International Scheme. In view of the advanced state of the cartography of Japan, the Netherland Indies and other countries, this work is deemed, by this Congress, to be urgent.

(2) That the various governments, which are engaged in the production of the International Map of the World on the scale 1: 1,000,000, be urged to publish, as quickly as possible, the sheets for which they are severally responsible.

(3) In the opinion of the Congress, a Geodetic Survey of Australia is an urgent necessity, alike on national economic and scientific grounds.

(4) That the Congress warmly appreciates the decision to proceed at once with the organization of the Commonwealth Solar Physics Observatory, and expresses the confident hope that the scientific results will fully recompense the Commonwealth Government for its scientific enterprise.

(5) In view of the unique opportunity for international cooperation afforded by the geographical position of the Toolangi Magnetic Observatory, and of the scarcity of magnetic observatories in the Southern Hemisphere, this Congress strongly urges that adequate provision be made by the Government of Victoria for the prompt reduction of the observations and publication of the results.

(6) That this Congress desires to place on record its appreciation of the investigations, valuable both to geophysicists and navigators, that have been carried out on the non-magnetic survey yacht "Carnegie," and expresses the hope that it will be possible to continue this work by the magnetic exploration of fresh ocean areas and by the determination of the secular variation of the magnetic elements.

(7) Understanding that the Imperial Government of Japan is considering the establishment of a geophysical and astronomical observatory on one of the Japanese mandatory islands in the Pacific, this Congress desires to express its belief in the scientific value of the scheme, and sincerely hopes that it may be carried out.

(8) That this Congress urges the speedy erection of wireless stations in all countries bordering the Pacific capable of communicating directly with each other. It is considered that practical progress in popularizing intercommunication by this means will be of great benefit in advancing the aims of the Congress for scientific unity.

(9) That this Congress recommends that arrangements be made for all wireless stations in and bordering on the Pacific to keep daily records on an approved basis with regard to static, its effect on wireless communication and its relation to meteorological conditions. That these records be compiled with a view to presenting an agreed statement of the total results at the next meeting of the Congress.

(10) That a speedier and more continuous interchange of knowledge between the nations in and bordering the Pacific will greatly aid the desired unity of scientific action, and the Congress urges each country concerned to promote research in long distance wireless telephony by giving to their individual experimenters the greatest freedom and facilities for development, having regard to non-interference with the regular transmission service.

(11) That the governments of the United States, France, Japan, Dutch East Indies, Australia and New Zealand be requested to establish a daily mean time signal and that this signal be transmitted at 8 P. M. local standard time from Tahiti, Funabashi, Cavite, Bandung, Perth, Adelaide and Melbourne, and 9 P. M. from Sydney and Wellington.

(12) That this Congress recommends that a scientific time signal be established and radiated from Honolulu consisting of 300 dots at intervals of approximately 0.98s. without any spaces; that this signal be transmitted with high power daily for about 5 minutes commencing at 1h. 01m. A. M. Greenwich Mean Time and that a circular be sent to all Pacific observatories possessing wireless facilities requesting astronomers to make the recording of coincidences a part of their daily routine and to forward results regularly to the secretary of the "Commission de l'heure" of the International Astronomical Union.

SECTION VII. GEOGRAPHY AND OCEANOGRAPHY

(1) That, whereas the Pan-Pacific Congress regards the 1: 1,000,000 map as of special value, and whereas only a few sheets of this map have been published by the countries bordering on the Pacific, the various governments which are parties to the Paris Convention of 1913 be urged to publish further maps as soon as possible.

(2) That this Congress wishes to emphasize the increasing importance of accurate coastal surveys being carried out in accordance with the recommendations of the International Hydrographic Bureau; that special attention be called to the scientific and economic interest of the construction of detailed charts of the Great Barrier Reef of Australia.

(3) That this Congress desires to call attention to the need for an adequate wireless meteorological service in the more remote parts of the Pacific Ocean and urges that the international exchange of meteorological information for the purposes of forecasting be extended to these regions.

(4) That the president of this Congress appoint a committee on the investigation of the temperature, salinity, hydrogenion concentration and currents of the Pacific Ocean, and that this committee be composed of at least one representative of each country represented at this Congress in which such investigations of the Pacific Ocean are now actively prosecuted.

(5) That this committee be requested to consider especially: (a) Data that have been accumulated on surface temperature of the Pacific Ocean and where they are deposited; (b) how these data may be made available; (c) what is the order of accuracy of the available data; (d) what improvements may be desirable in taking records of surface temperature and if improvements are needed how may they be effected; (e) types, purchase-cost, cost of installation, and cost of operation of oceanographic thermographs.

(6) That this committee be requested to take such steps as may seem appropriate to advance the study of the subjects mentioned in this motion and of cognate subjects, and that it report at the next Pan-Pacific Science Congress.

SECTION VIII. GEOLOGY

(1) That in view of the experience gained in countries in which geological surveys are well advanced this Congress records its opinion that accurate topographical and geological maps provide the most effective and economical basis for the development of the mineral resources, including ground water, of any country.

(2) That geological maps of the Pacific countries on a scale of 1: 1,000,000 be completed at as early a date as possible, and that a committee consisting of representatives of the different countries concerned be appointed to expedite this work.

(3) *Whereas*, it is felt that there are many geological problems in the Commonwealth which call for investigations in areas transgressing the boundaries of the states, there seems to be a well-established case for a Federal Geological Survey.

It is considered that such work should supplement rather than displace the geological activities of the states, and it is considered also that general geological work will be of immense value in the development of mineral resources even if not carried out directly with that object in view.

Moreover, the wise administration of the Northern Territory can be effected only with geological assistance, and the work now being carried out in Papua, excellent though it is, requires extension to a degree commensurate with the area and importance of this region. In Papua and the Northern Territory the mineral resources vest in the Commonwealth Government, and their full development demands adequate geological organizations. The Pan-Pacific Science Congress suggests that the Commonwealth Government establish a Federal Geological Survey (provided always that this proposal is approved by the state governments).

(4) That this Congress has been greatly impressed with the scientific and economic value of the results achieved in Papua by the government geologist and it expresses the hope that these investigations may receive increased support.

(5) That a geological survey of the Fiji Islands is desirable both on scientific grounds, particularly in throwing light on the origin of coral reefs and on earth movements in the Pacific Region, and because it may procure valuable information on the mineral resources of the islands and can not fail to be of great assistance in opening up the country for settlement.

(6) Since it is desirable to arrange for a more systematic treatment of the tectonic features of the Pacific Region, it is recommended that a committee composed of members from the principal countries concerned be appointed to draft an outline for papers dealing with this subject at the next Congress.

(7) That it is important to institute a series of observations in the Pacific Ocean in critical areas of crustal unrest for the accurate determination of latitude and longitude. These observations should be repeated at regular intervals, say, once in every five years, in order to ascertain what horizontal movements may be involved in such areas of instability. The selection of the localities should be done by a committee appointed by the Congress.

(8) That, in view of the importance of meteorological and seismological observations in the Pacific area, this Congress urges that the staff and equipment of the observatory at Samoa should be increased, so that it may efficiently continue the good work already begun.

(9) That in view of the scientific and economic results which would accrue from the systematic study of the thermal region of New Zealand the Pan-Pacific Science Congress strongly commends the proposal for the establishment of a seismological and volcanic observatory in that region.

(10) That it is desirable that different agencies cooperate in the study of coral reefs, and it is particularly suggested that where practicable aeroplane surveys be made.

(11) The Pan-Pacific Science Congress views with much satisfaction the establishment of the committee recently formed for the purpose of investigating the problems, both scientific and economic, of the Great Barrier Reef and heartily endorses the general plans which are being formulated for carrying out the scientific investigations.

SECTION IX. HYGIENE

That the scientific problem of the Pacific which stands first in order of urgency is the preservation of the health and life of the native races by the application of the principles of the sciences of preventive medicine and anthropology.

SECTION X. VETERINARY SCIENCE

(1) That an International Bureau of Animal Health be established; that all countries represented at the Pan-Pacific Science Congress forward to the bureau a monthly notice of all outbreaks of contagious and infectious diseases of animals and an annual report of their personnel, activities, etc.; that the bureau be a coordinating center to transmit all such information to countries represented at the Pan-Pacific Science Congress monthly and annually as the case requires.

(2) In view of the importance of the animal industries in the Pacific regions, it is recommended that greater encouragement be given to the study of animal genetics to improve the breeds of productive animals in the various countries.

(3) (In conjunction with Zoology): That this Congress expresses its appreciation of the work already done by the Commonwealth and state governments of Australia in protecting the unique native fauna of their territories; that this Congress affirms the desirability of establishing further faunal sanctuaries in Pacific countries where interesting and valuable native animals are in danger of extinction.

(4) In view of the increasing importance of the livestock industry in Papua and the Australian mandated territories, this Congress recommends that a veterinary survey of those regions be carried out by the Commonwealth Government under the direction of a veterinary bacteriologist experienced in the tropical diseases of animals.

SECTION XI. ZOOLOGY

(1) That it is desirable that investigation and survey of terrestrial and marine fauna and flora of countries in and surrounding the Pacific should be carried on through the agency of existing institutions and societies, and that for this purpose such countries should be divided into unit areas of which the Commonwealth of Australia and its territories together should constitute one.

That where this investigation is not being adequately

carried out, the National Research Council for the area be urged to initiate and further the work.

(2) *Whereas:* (1) It is certain that many economically valuable species of marine mammals such as fur seals, sea otters, whales and elephant seals and dugongs once occurred in various portions of the Pacific in such numbers as to constitute the bases of important industries; (2) extremely unwise and wasteful modes of prosecuting these industries have resulted in reducing most of these animal resources nearly to commercial extinction; (3) it is known that small remnants of many of these species still exist in widely separated regions of the Pacific; (4) there are excellent grounds, notably in the rehabilitation of the Behring Sea fur-seal herds under this protection of international treaty for believing that many of these depleted species could be restored to their former abundance by protective measures; *therefore, be it resolved:* That, with a strong belief in the possibility of securing the restoration and perpetuation of many of these useful animals, this second Pan-Pacific Science Congress recommends that: Steps be taken at once by the nations of the Pacific having interests in these species either acting independently or jointly in cases where independent action would be ineffective (a) to make a thorough scientific investigation of the present condition, the history, and the scientific and economic worth of these species with a view to such action as may be necessary to secure the desired end; and (b) to obtain such governmental measures, either by the nations concerned acting separately or jointly where necessary by international convention as would make effective the measures found essential by the scientific investigations for the protection and restoration of the depleted herds and species.

(3) (Endorsed by Geography Section.) In view of (a) the wealth of marine life, including the microplankton at one extreme and fishes and marine birds and mammals at the other, in certain portions of the Pacific Ocean; (b) the seeming barrenness of certain other parts; (c) our very imperfect knowledge of the delimitation of these areas and of the physical and other conditions which determine the fertility or otherwise of a given oceanic area; (d) the moral certainty that with the growth of population in the Pacific Region, already dense in some portions thereof, the future will be obliged to requisition these sources of organic life for food and other human needs, much more extensively than is now the case; and finally (e) the slowness and difficulty of gaining reliable knowledge in this domain of science; *therefore, be it resolved:* That the Second Pan-Pacific Science Congress urges upon the nations of the Pacific the importance of researches in all those aspects of oceanography, physical and biological, essential to an understanding of the organic productiveness of the Pacific and to the utilization and conservation of such portions of that productiveness as may be available for the needs of mankind; and further, that this Congress urges the necessity for the establishment of marine biological stations upon such portions of Pacific coasts as do not already possess them.

HERBERT E. GREGORY

THE FRIENDS OF MEDICAL PROGRESS

Two years ago the Committee for the Protection of Animal Experimentation was organized in Boston to cope with an unusual period of activity on the part of local antivivisection cults. The work of the Committee was successful. For a year or more after this emergency there was a wide correspondence and much discussion both here and with England, where a Defense of Research Society became necessary some years ago. For many years our physicians have carried on the freedom of research defence here in America purely as a civic duty and with much expenditure of time and energy and they have been far more successful than their English colleagues. Abroad they made an unfortunate compromise, with the antivivisectionists who nevertheless now cry louder than ever for the total abolition of all Animal Experimentation. Latterly these misguided cults in America have been increasing in power as their funds have gradually accumulated.

Therefore there has been an insistent and widespread demand that the work of the old Committee be given permanent form and a National Society in the control of Laymen has been organized called the Friends of Medical Progress. The purpose of this Society is not controversial but educational, along the broadest lines, and the articles of incorporation state its purposes as follows:

(1) To encourage and aid all research and humane experimentation for the advancement of medical science; (2) to inform the public of the truth concerning the value of scientific medicine to humanity and to animals; (3) to resist the efforts of the various persons and societies constantly urging legislation dangerous to the health and well-being of the American people.

The Committee did much to protect experimentation in biological laboratories and the new Society is naturally likewise committed to the same policy. The officers of the Society are:

Honorary President

CHARLES W. ELIOT

President Emeritus Harvard University

President

THOMAS BARBOUR

Museum of Comparative Zoology, Cambridge, Mass.

Secretary

EDWARD WIGGLESWORTH

Director, Boston Museum of Natural History

Treasurer and Assistant Secretary

MARY LEE THURMAN

28 Newbury St., Boston, Mass.

Field Secretary
ERNEST HAROLD BAYNES
Meriden, N. H.

The following distinguished list of Honorary Vice Presidents have consented to serve:

JAMES ROWLAND ANGELL
President of Yale University
HON. CHARLES EVANS HUGHES
Washington, D. C.
THE RIGHT REV. ALEXANDER MANN
Bishop of Pittsburgh
HIS EMINENCE, WILLIAM CARDINAL O'CONNELL
Archbishop of Boston
MISS ELLEN F. PENDLETON
President of Wellesley College
ERNEST THOMPSON SETON
Greenwich, Connecticut
OWEN WISTER
Philadelphia, Pennsylvania

The Medical Advisory Board consists of:

W. W. KEEN, M.D., *Chairman*
Philadelphia, Pennsylvania
CHARLES C. BASS, M. D.
Tulane University
MONTROSE T. BURROWS, M.D.
Washington University, St. Louis, Mo.
WALTER B. CANNON, M.D.
Harvard Medical School, Boston, Mass.
CHARLES P. EMERSON, M.D.
University of Indiana
SIMON FLEXNER, M.D.
Rockefeller Institute
WILFRED T. GRENFELL, M.D.
St. Anthony, Newfoundland
WILLIAM J. MAYO, M.D.
Rochester, Minnesota
GEORGE W. MCCOY, M.D.
Hygienic Laboratory, Washington, D. C.
HENRY SEWALL, M.D.
Denver, Colorado
H. GIDEON WELLS, M.D.
Sprague Memorial Institute, Chicago, Ill.
GEORGE H. WHIPPLE, M.D.
University of Rochester, New York
DAVID S. WHITE, M.D.
Ohio State University, Columbus, Ohio
RAY LYMAN WILBUR, M.D.
Leland Stanford University, California

During a recent address before the American Public Health Association, Dr. George E. Vincent, of the Rockefeller Foundation, stated the aims of the Society in the following terms (no better summary is possible):

What the layman needs is education in the significance of modern science and especially with regard to medical science. He is troubled by what the anti-vivisectionist says. He wonders whether all these people that he has respected and heard about are engaged in this awful torture of poor suffering creatures—wonders what it is all about. He is subjected all the time to the constant campaigns of societies that are organized to propagate these absurd notions about anti-vaccination and anti-vivisection. There is a systematic, well-organized propaganda going on in the United States, endowed and backed by large contributions from a large number of honest and fanatical people. Honest and fanatical people are the worst combination possible. You need not worry about people whose motives are bad. They usually take care of themselves, but a great mass of perfectly wrong-headed and nobly devoted people to a cause are a fearful calamity to any country, and we suffer from them.

We have all this organized wrong-headedness in this country, and it is not a thing to laugh at or despise; it is not a thing to suppose can be left alone and it will somehow burn itself out.

Therefore, I am sure that all of us have welcomed the organization of a society that frankly, systematically, intelligently and honestly proposes to enter the field to combat these dangerous ideas which are spreading and which are confusing the minds of the average layman. There has been organized the society known as the Friends of Medical Progress. The honorary president of it is that great man, that man whom we all honor and revere, that man who has been a force in American life that it is impossible to estimate, a man who in what in other men would be old age, is still possessed of all his vision, all his courage, idealism, all his interest in human affairs—President Eliot, of Harvard University.

This society is beginning a systematic, scrupulous, careful, thorough, scientific and conscientious campaign to educate the public of America as to the meaning of modern medicine, the meaning of modern science, the methods which modern science utilizes, what animal experimentation is. We have to call it vivisection because the people who are attacking it constantly talk of vivisection, and they say that calling it anything else is dodging the issue.

This society issues pamphlets and urges people to understand the meaning of animal experimentation, what it has done for public health and the benefit of mankind. This is a society which every member of this association ought to support, every member of this association ought to join, and it is hoped in communities all over the United States branch societies will be organized until we have a federation throughout this country of intelligent laymen keeping their heads, trying to get the right kind of information, going carefully into these things, running down rumors, having things investigated.

You know every time you have a talk about vaccination, somebody says that vaccination always results in tetanus, kills more people than it saves, and all that sort of thing. We need in every community throughout this country a group of right-minded, courageous men and women banded together to see that the American public gets the absolute truth with regard to this whole question.

So therefore the Society of Friends of Medical Progress has been founded because there is an or-

ganized, widespread and dangerous movement on foot to discredit the medical profession, to procure legislation which will prevent the progress of medicine and surgery, to break down the bulwarks of preventive medicine, and thus expose our people to the attacks of diseases which are now held in check by science, but which formerly took frightful toll of human life. This anti-medical campaign is being conducted by a considerable number of organizations professing various aims, such as antivivisection, antivaccination and "medical liberty," but all seeking by fair means or foul to bring into disrepute scientific methods of combating disease, and to substitute therefor every known form of pseudo-science and quackery.

The present headquarters of the Society are at 28 Newbury Street, Boston, Mass., in the house of The American Academy of Arts and Sciences by kind permission. The Society has a large quantity of educational literature available for distribution and sincerely hopes that every layman as well as every medical and biological investigator in America who may read this announcement will correspond with Miss Mary Lee Thurman, 28 Newbury Street, Boston, Mass., with a view to becoming a member of the Society and not only this but that they will give the Society whole hearted encouragement and support.

THOMAS BARBOUR

JOHN THOMAS GULICK, MISSIONARY AND DARWINIAN

JOHN THOMAS GULICK, son of a missionary, was born in Hawaii in 1832, and died recently in Honolulu at the age of ninety years. He has been widely and very favorably known as a student of the land snails of Hawaii (*Achatinellidae*), and of the lessons in evolution to be derived from their nature and distribution. He was greatly impressed, seventy years ago, with Darwin's account in "The Voyage of the Beagle," of the birds and reptiles of the Galapagos Islands, and the suggestion of localization as a moulder and determinant of forms. He found conditions even more striking existing in Hawaii. The many species of land snails on those islands occupy each a restricted area separated by barriers of stream or meadow which these slow-moving creatures practically never crossed. As he recorded the multitude of forms, the conviction grew with him that the relation of these geminate species of shells "was a marvelous self-revelation from the hand of the Creator himself and that if we could but learn the alphabet we might read from them the story of His method of creation."

Dr. Gulick, a graduate of Williams College (1859), spent most of his life as a missionary in China and Japan. Even before he had read "the Origin of Species" he had reached the conclusion that "many genuine species had been derived from descent from one original stock or species." To find out the range of this possibility and how it came about he devoted his spare time for many years. His first paper: "The Variation of Species as related to their Geographical Distribution," was published in *Nature* in 1872. Numerous other papers on the formation of species through isolation and segregation followed, the most extensive being a volume, "Evolution, Racial and Habitual," issued by the Carnegie Institution.

Nearly all Dr. Gulick's scientific work relates to the multitude of genera and species of these tree snails of a family peculiar to small groves and thickets. No one considering the wealth of illustration given by Dr. Gulick can fail to recognize that isolation has been the immediate occasion of the moulding of each of the various forms; and while the evidence in most other groups of plants and animals is not so clearly visible, every competent field-worker finds the same factor in the origin of practically every species whatever. Adaptation is produced by Natural Selection: the final differential moulding by isolation and segregation.

In the details of his work Dr. Gulick was far ahead of his time, not many laps indeed behind Darwin, and in general conception of methods of evolution he is still in advance of many able workers who are prone to forget what they have not themselves seen. The internal factors in evolution, heredity and variation, are recognized by all authors. The external factor, selection, has been fully illustrated by Darwin, and can apparently be questioned only through ignorance or perversity. Another external influence, isolation with segregation, was regarded by Darwin as a feature of natural selection, its vital importance being overlooked by naturalists who have not studied wild life in nature's own workshops.

It is worth noting in these days of conflicts between knowledge and prejudice that Dr. Gulick was a thoroughgoing Darwinian, as well as a Christian missionary. His scientific studies were to him a reverent duty, a study of the actual ways of the Creator in His actual handiwork.

Dr. Gulick, after a happy and successful life, attained a happy old age. One of the red-letter days of the present writer was in 1922, when he received an invitation to Gulick's charming home in Honolulu, where, himself a champion of *"räumliche Sonderung"* as a necessary factor in evolution, he was privileged to stand by Gulick's side when one who had studied with both of us took our photograph together.

DAVID STARR JORDAN

SCIENTIFIC EVENTS

INTERNATIONAL PATENTS

IT is announced in *Nature* that the council of the Trade Marks, Patents and Designs Federation, Ltd., recently circulated a questionnaire in relation to trade marks, patents and designs prepared by the International Chamber of Commerce to a number of societies interested in these matters. This questionnaire was drawn up with the object of ascertaining the directions in which modifications and amendments were desirable, from the British point of view, in the International Convention for the Protection of Industrial Property, signed at Washington on June 2, 1911. A meeting of the representatives of some twenty of the societies consulted was held at Lever House, Blackfriars, on November 23.

The questionnaire was discussed, and it was recommended, *inter alia,* that (1) a clause should be inserted in the convention abolishing revocation of patent rights either for non-working or for abuse of monopoly, but permitting each country at its discretion to grant compulsory licenses in such cases; (2) provision should be made for establishing in all convention countries a uniform period of duration for patents, and renewal fees should be paid at agreed intervals of time and be based on a sliding scale system of progressively increasing payments; (3) there should be uniform provisions governing the use of an invention on vessels sailing under the flag of one of the states which has adhered to the convention; (4) there should be provision for registration in a public register kept by the competent administration of each country of all assignments and licenses affecting the legal proprietorship of patent rights; (5) steps should be taken to secure a greater degree of uniformity in the regulations at present in force in the various convention countries with respect to the procedure to be followed on applications for the grant of letters patent. It was further agreed that it was neither desirable nor practicable to insist upon the institution in all convention countries of a system of preliminary search of patent applications, but it was desirable that any party interested should have the right, prior to the grant of any patent, to institute opposition proceedings based on all prior publications or public users of the invention.

THE MORTALITY FROM TUBERCULOSIS AND CANCER

THE Department of Commerce announces that compilations made by the Bureau of the Census show that 90,452 deaths were due to tuberculosis in the registration area of the United States in 1922, with a death rate of 97 per 100,000 population. This is a drop of 2.4 since 1921, in which year the rate was 99.4. Though 12 states show increases in rates for 1922, in 22 states there are decreases, indicating that the general trend is still downward.

To permit better interstate comparisons for the year 1922, adjusted rates based on the standard million population have been calculated. The highest adjusted rate from tuberculosis for 1922 is 172.6 per 100,000 population for Colorado and the lowest is 36.1 for the adjoining state of Nebraska. The high rate for Colorado should not be ascribed to unhealthfulness of climate, but rather to the fact that the climate attracts those afflicted with tuberculosis.

For certain states adjusted rates have been calculated separately for the white and colored populations. In this group of states Tennessee has the highest adjusted rates for both white and colored (respectively, 121.8 and 299.8 per 100,000 population). The lowest adjusted rate from tuberculosis for white population is 54.5 for Mississippi and this State and Florida each shows the lowest rate for colored population (171.5 per 100,000 population).

Cancer caused 80,938 deaths in the death registration area in 1922, which comprised about 85.3 per cent. of the total population of the United States, and if the rest of the United States had as many deaths from this cause in proportion to the population the total number of deaths from cancer in the entire United States was 95,000 for 1922, against a corresponding estimate of 93,000 for 1921.

The death rate from cancer in the registration area in 1922 was 86.8 per 100,000 population as against 86 in 1921. Only five states show lower rates for 1922 than for 1921. In comparing the death rate from cancer in one state with that in another, the bureau uses "adjusted" rates in order to make allowance for differences in the age and sex distribution of the population, because, generally speaking, only persons in middle life and old age have cancer, so that a state with many old persons may be expected to have more deaths from cancer than a state with comparatively few old persons.

The highest adjusted cancer rate for 1922 is 106.9 per 100,000 population for the state of Rhode Island and the lowest is 53.1 for Tennessee. For a few states adjusted rates have been calculated separately for the white and colored populations. In this group of states the highest adjusted rate for the white population is 92.5 per 100,000 for Maryland and the highest for the colored population is 81.7 also for Maryland. The lowest adjusted rate for white population is 52.8 for Tennessee and the lowest rate for the colored population is 40.8 for Florida.

TRANSPORTATION INSTITUTE LECTURES

ONE of the projects of the National Transportation Institute has been made an actuality by the starting of the institute's lecture course on transportation. The course is to be given by leading educators at colleges and universities throughout the country. The program was inaugurated by the giving of the first lecture at Fairmount College, Wichita, Kans., by Carleton B. Hutchings, secretary of the institute. The second lecture at Fairmount College was by Professor Arthur H. Blanchard, professor of highway engineering and highway transport at the University of Michigan. The third lecture at Fairmount was by Professor Charles L. Raper, dean of the College of Business Administration of Syracuse University.

These short courses of lectures are scheduled already at sixteen colleges and universities in the Middle West, and are being arranged at other institutions. Colleges that have arranged for lecture courses include: Fairmount College, Wichita, Kans.; Ottawa University, Ottawa, Kans.; Kansas Agricultural College, Manhattan, Kans.; Bethany College, Lindsborg, Kans.; Cornell College, Mt. Vernon, Ia.; Coe College, Cedar Rapids, Ia.; Simpson College, Indianola, Ia.; Grinnell College, Grinnell, Ia.; Penn College, Oskaloosa, Ia.; University of Detroit, Detroit, Mich.; Albion College, Albion, Mich.; Hillsdale College, Hillsdale, Mich.; Kalamazoo College, Kalamazoo, Mich.; Adrian College, Adrian, Mich.; Alma College, Alma, Mich.

University professors of transportation and nationally known authorities on economics have joined with the institute to give the courses. Those already engaged in the work, besides Professor Blanchard and Professor Raper, include: Professor Frank H. Dixon, professor of economics and social institutions, Princeton University; Professor G. W. Dyer, professor of sociology, Vanderbilt University, Nashville, Tenn.; Dr. David Friday, director of research, National Transportation Institute, former president Michigan Agricultural College; Professor Emory R. Johnson, professor of transportation, University of Pennsylvania; Professor H. G. Moulton, director, Institute of Economics, Washington, D. C.; Professor C. O. Ruggles, professor of transportation and public utilities, Ohio State University; Professor T. W. Van Metre, professor of transportation, Columbia University, and Professor Harold Whitehead, Boston University.

POWER SURVEY OF PENNSYLVANIA

As a commission from Governor Gifford Pinchot a power survey of the state of Pennsylvania has been instituted by the commercial engineering department of the Carnegie Institute of Technology. Dr. W. F. Rittman, head of the department, and Professor Sumner B. Ely are making the survey under the directorship of Morris L. Cooke, of Philadelphia.

The purpose of the study is to determine the approximate consumption of horse power necessary to operate Pennsylvania industries over a given period of future years. In order to make such an estimate possible, the engineers of the Carnegie Institute of Technology have been asked to survey the total consumption of power used in the state industries in the past twenty years.

An important possibility coming from the survey concerns the conservation of power and energy in the operation of the state industries. The need of power conservation, either through drastic curtailment of energy or by methods of distribution to the points most needed, is receiving serious consideration by the U. S. government, and by many state engineering departments. In Pennsylvania, power conservation is considered to be even more serious than elsewhere because of the tremendous consumption of energy in the Pittsburgh District.

Because of the relative importance of the state survey, Dr. Rittman and Professor Ely have been assured of the utmost cooperation by engineers and heads of industries throughout the commonwealth. They have completed a power survey of the Pittsburgh District upon their own initiative, and will have the information derived from this study at their disposal. It is planned to complete the survey by the end of summer of 1924.

Governor Pinchot's faith in the possibilities of a power survey of the state is expressed in the following statement:

> In an advancing social order, power must be both cheap and plentiful. Therefore every possible economy must be practiced. This implies the conception of a state-wide (and ultimately a nation-wide) reservoir or pool of power into which we may pour energy from whatever source, and from which storage we may take out energy to meet widely diversified scattered needs.

Giant power means cutting out waste. The burning of raw coal in power plants and on our railroads has come to be recognized as waste, involving as it does the loss of by-products, such as ammonia, needed for fertilizer on the farm; tar for road-building, and other hydrocarbons useful as dyestuffs and otherwise in the industries. If these economies can be realized through building large scale by-product distillation and power plants at the mines, it will mean cheaper power because of the reduction in the cost of fuel, which to-day constitutes upward of three quarters of the whole cost of steam-developed electric current. Such giant power plants will accomplish the further economy of utilizing the coal near the mines, and thereby releasing all facilities for other purposes.

THE HISTORY OF SCIENCE SECTION OF THE AMERICAN ASSOCIATION

ON Saturday, December 29, at 10 o'clock, the first session of the History of Science Section will take place, with Dr. Florian Cajori, of the University of California, as chairman.

I. History of Early American Astronomical Observatories (Illustrated).
Dr. W. CARL RUFUS, University of Michigan.

II. The Early History of Terrestrial Magnetism and the Work of John Locke of Cincinnati (Illustrated).
DR. LOUIS A. BAUER, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

III. The Historical and Practical Aspect of Meteorology, especially the work of Cleveland Abbe, and the United States Weather Bureau (Illustrated).
DR. W. J. HUMPHREYS, U. S. Weather Bureau, Washington, D. C.

IV. Uniformity of Mathematical Notation in the Light of History. Retiring Address as Chairman and Vice-President for the Section.
DR. FLORIAN CAJORI, University of California.

V. Drawing Instruments of Two Hundred Years Ago (Illustrated).
PROFESSOR EDWIN W. SCHREIBER, Proviso Township High School, Ill.

On the afternoon of Monday, December 31, a joint meeting of the History of Science and the Philological Sections will take place. This meeting will be in the nature of a symposium and an informal recognition of the 300th anniversary of Lord Francis Bacon's publication of "Novum Organum." The importance of this meeting will be to point out that the philosophy of science had its origin in the inductive methods of Bacon.

I. The Historical Setting of the Work of Francis Bacon.
DR. HARRY E. BARNES, Smith College.

II. Bacon the Founder of Modern Research.
PROFESSOR MARK H. LIDDELL, Purdue University.

III. Baconian Methods of Scientific Research.
DR. FLORIAN CAJORI, University of California.

IV. Knowledge is Power.
DR. W. A. CROWLEY, University of Cincinnati.

V. Discussion.

FREDERICK E. BRASCH,
Secretary

THE MEDICAL SCIENCES AT CINCINNATI

SECTION N, Medical Sciences, of the American Association for the Advancement of Science, will meet at the University of Cincinnati, December 29, under the chairmanship of Professor Richard P. Strong, of Harvard University. The morning session is to be devoted to a discussion of the interrelated problems of the medical worker, the parasitologist, the medical entomologist, etc.

1. Professor Francis W. Peabody, Harvard University, will speak on the rôle of Section N.

2. Dr. L. O. Howard, U. S. Bureau of Entomology, "Notes on medical entomology," which will include his recent studies in the European stations of tropical diseases.

3. Professor Richard P. Strong, director of Tropical Diseases, Harvard University, "Relationship of certain parasitic infections of plants to animals." This paper will include his recent studies in Central and South America.

4. Professor Henry B. Ward, of the University of Illinois, will discuss the problem from the point of view of the parasitologist.

The afternoon session will be devoted to a discussion of the endocrines.

1. Professor George W. Crile, Western Reserve University, will speak on "Endocrinology" from the point of view of the surgeon.

2. Professor R. G. Hoskins, Ohio State University, from the point of view of the physiologist.

3. Professor Thomas R. Sprunt, the Johns Hopkins University, from the point of view of the internist.

4. Professor J. J. R. Macleod, University of Toronto, on "Insulin."

On this Seventy-fifth Anniversary of the founding of the association the speakers will also review the historical developments of each of their sciences. All interested workers are invited.

W. J. GOLDFARB,
Secretary

SCIENTIFIC NOTES AND NEWS

THE Section of Geology and Geography of the American Association for the Advancement of Science has made arrangements to celebrate, at Cincinnati, the seventy-fifth anniversary of the association, in the foundation of which the earlier geologists played so prominent a part. The section has secured the consent of Professor T. C. Chamberlin, who recently celebrated his eightieth birthday, to speak on the subject "Seventy-five years of American Geology." Professor William Morris Davis, of Harvard University, will give an address on "The Development of Geography in the United States" and Professor H. L. Fairchild, of the University of Rochester, will speak on some of the early geologists.

THE Association of American Geographers will hold its twentieth annual meeting at Cincinnati from December 27 to 29. On the evening of December 28,

Dr. Ellsworth Huntington will deliver his presidential address on the "Materials for human geography, as illustrated in Japan, Java and Australia."

THE American Society of Zoologists will meet at Cincinnati from December 27 to 29, with its annual dinner Friday evening. Professors N. K. Koltzoff and P. P. Lazareff, of Moscow, will be guests of the society and will give addresses. Saturday afternoon will be devoted to a joint symposium with the botanists and the naturalists on "Morphogenesis." Professors C. M. Child, R. S. Lillie, A. H. Reginald Buller and R. A. Harper will speak.

THE Genetics program at the joint Genetics Sections of the American Society of Zoologists and the Botanical Society of America, meeting with the American Association for the Advancement of Science, at Cincinnati, has been arranged in three sessions to be held on Thursday and Friday, December 27 and 28. Titles of 22 papers on botanical subjects have been listed for the Thursday morning and afternoon sessions. Seventeen papers on zoological subjects will be given Friday morning.

THE Geological Society of America meets at Washington from December 27 to 29 under the presidency of Dr. David White. Meeting with the society are the Paleontological Society of America, Dr. T. W. Vaughan, president, and the Mineralogical Society of America, Edgar T. Wherry, president.

THE American Anthropological Association, of which Dr. Walter Hough is president, meets in New York City on December 27 and 28.

THE American Psychological Association meets at Madison, Wisconsin, under the presidency of Professor Lewis M. Terman, of Stanford University, on December 27, 28 and 29.

THE American Astronomical Society, of which Dr. W. W. Campbell is president, meets at Poughkeepsie from December 27 to 29.

THE American Mathematical Society, of which Professor Oswald Veblen, of Princeton University, is president, meets in New York on December 27, 28 and 29. The Chicago section of the association and the Mathematical Association of America, of which Professor R. D. Carmichael is president, meets at Cincinnati in affiliation with the American Association.

THE Federation of Biological Societies meets at St. Louis on December 27, 28 and 29.

PROFESSOR SOLON IRVING BAILEY, senior member of the staff of the Harvard College Observatory and Phillips professor of astronomy at Harvard since 1912, who has been in charge of the station at Arequipa, Peru, for the last two years, has been given the degree of doctor of science by the University of San Augustin at Arequipa, Peru, and at the same time was made honorary professor of astronomy at the university.

THE degree of master of arts, *honoris causa,* is to be conferred by the University of Cambridge on Mr. J. B. Buxton, professor of animal pathology.

PROFESSOR ARNOLD THEILER, director of the Bacteriological Institute of Pretoria, has been made a doctor of philosophy, *honoris causa,* by the University of Berne.

PROFESSORS A. KNESER, of the University of Breslau, and E. Study, of the University of Bonn, mathematicians, have been elected corresponding members of the Prussian Academy of Sciences.

THE title of emeritus professor has been conferred by the University of Leeds on Dr. Arthur Smithells, who recently retired from the chair of chemistry, on the grounds of intellectual distinction and of long and meritorious service to the university.

DR. F. N. COLE, professor of mathematics in Columbia University, has been granted leave of absence for the second half of the present academic year.

PAUL F. CLARK, PH.D., professor of medical bacteriology at the University of Wisconsin, has returned from a semester's leave of absence. Dr. Clark served as delegate at the Pasteur centenary in Paris.

DR. JAN METZELAAR, formerly fisheries instructor for the Dutch Government, has been appointed fisheries expert for the department of conservation of the State of Michigan. His headquarters will be at the Museum of Zoology, University of Michigan.

BERNHARDT G. HARTMANN has been transferred from the Chicago Food and Drug Inspection Station of the Bureau of Chemistry to the Food Control Laboratory, Bureau of Chemistry, Washington, D. C.

J. E. UNDERWOOD has resigned his position as research chemist with the Radium Emanation Corporation, to join the staff of the National Lime Association as assistant chemical directors.

F. HAZLEWOOD has resigned from the ceramics section of the U. S. Bureau of Standards, Washington, D. C., to accept a position with the Buffalo Pottery Co., Buffalo, N. Y.

PROFESSOR ALEXANDER MAIR, of the University of Liverpool, has been elected president and Dr. Betts Taplin vice-president of the newly organized Liverpool Psychological Society.

AT a meeting of the New York Academy of Medicine on December 6, the following officers were elected: vice-president, three years, Dr. Herbert S.

Carter; corresponding secretary, three years, Dr. D. Bryson Delavan; treasurer, three years. The president is elected for a two-year term; Dr. George David Stewart continues to hold this office.

AT the annual meeting of the Institute of Chemical Engineers, held in Washington on December 5, 6 and 7, the following officers were elected: Dr. Charles L. Reese, chemical director of the du Pont Company, president, to succeed Dr. Henry Howard, who had completed his second term. H. K. Moore, of the Brown Co., Berlin, N. H., automatically became first vice-president and Dr. H. S. Miner, of the Welsbach Co., became second vice-president. The office of third vice-president is filled by election and Professor A. H. White, of the University of Michigan, was chosen for this office. Other officers were elected as follows: J. C. Olsen, *secretary*; F. W. Frerichs, *treasurer*; David Wesson, *auditor*; W. L. Badger, F. A. Lidbury and A. E. Marshall, *directors*.

OFFICERS of the Optical Society of America for 1924–1925 have been elected as follows: *President,* Herbert E. Ives, New York; *Vice-President,* W. E. Forsythe, Nela Research Laboratories, Cleveland; *Secretary,* Irwin G. Priest, Bureau of Standards, Washington; *Treasurer,* Adolph Lomb, Bausch and Lomb Optical Company, Rochester; *Members of the Executive Council, Ex officio,* the above officers and the past president, Leonard T. Troland, Harvard University, the editor-in-chief of the journal, Paul D. Foote, Bureau of Standards, the assistant editor-in-chief and business manager of the journal, F. K. Richtmyer, Cornell University; *Elected,* K. T. Compton, Princeton University; Carl W. Keuffel, Keuffel and Esser; P. G. Nutting, Schenectady, and F. E. Wright, Carnegie Geophysical Laboratory.

ROBERT AMORY, president of the National Association of Cotton Manufacturers and Mr. H. C. Meserve, secretary of that organization, recently delivered lectures at Princeton University on the cotton industry and its development. The lectures were delivered under the Cyrus Fogg Brackett Lectureship in applied engineering technology. Among the lecturers of the past two years in this foundation are Samuel Insull, of Chicago; John A. Britton, of San Francisco; J. W. Lieb, of New York; Ralph Modjeski, of Philadelphia, and William S. Lee, of Charlotte, N. C.

AT a meeting of the New York Section of the Illuminating Engineering Society, on December 13, Mr. Lawrence A. Hawkins, engineer of the Research Laboratory of General Electric Company, presented a paper entitled "The light of knowledge and the knowledge of light."

PROFESSOR GEORGE GRANT MACCURDY, of Yale University, was the speaker at the meeting of the Galton Society, held on December 5 at the American Museum of Natural History, New York, his subject being "Nature as reflected in Paleolithic Art."

DR. I. NEWTON KUGELMASS, of Yale Medical School, addressed the Bio Club of the College of the City of New York on November 8 on "The Relations of Colloid Chemistry to Medicine." On December 20, Dr. L. I. Dublin, statistician of the Metropolitan Life Insurance Company, will address the club on the problem of "Longevity."

THE Pasteur Lecture was delivered by Dr. Otto Folin, of Harvard University Medical School, Boston, on November 23, before the Institute of Medicine of Chicago. His subject was "What we have learned about uric acid."

PROFESSOR FRANCIS E. LLOYD, of McGill University, lectured on the subject "Fluorescence in plants" before the Royal Canadian Institute, on December 1. He will deliver a lecture on the same subject at the University of Kentucky, Louisville, Ky., on January 3 next.

DR. JOHN MAXSON STILLMAN, emeritus professor of chemistry at Stanford University, died on December 13, aged seventy-one years.

UNIVERSITY AND EDUCATIONAL NOTES

MRS. MARY COUTS BURNETT has conveyed to the Texas Christian University of Fort Worth, Texas, an estate valued at $4,000,000 and $150,000 in cash. Under the terms of the deed of trust three fourths of the annual income goes to Mrs. Burnett during her lifetime.

THE Education Research Committee of the Commonwealth Fund has made to the University of Chicago an appropriation of $14,000 to enable Director Charles Hubbard Judd, of the School of Education, and Associate Professor Guy T. Buswell, to make a study of methods of teaching arithmetic, similar to studies which recently have been made in reference to reading.

DR. JAMES M. SHERMAN, bacteriologist in the Research Laboratories of the Dairy Division, U. S. Department of Agriculture, has been appointed head of the Department of Dairy Industry at Cornell University.

DR. IRWIN ROMAN, of Northwestern University, has been appointed associate professor of mathematics at Vanderbilt University.

PROFESSOR J. C. MANRY has returned to Ewing Christian College, Allahabad, India, after completing his work for the doctor's degree in psychology at the University of Iowa. Dr. Herbert G. Kribs, late of

the department of zoology of the University of Pennsylvania, has joined the same institution as professor of zoology. Walter D. Kline, Ph.D. (Yale, '23) becomes professor of chemistry.

PROFESSOR E. STRÖMGREN, of the University of Copenhagen, has been called to a professorship of theoretical astronomy at the University of Berlin.

DR. G. HERGOLTZ, of the University of Leipzig, has been called to a professorship of mathematics at the University of Munich.

DISCUSSION AND CORRESPONDENCE

HAEMATOXYLIN

HAEMATOXYLIN is a natural dye found in logwood, and requires only to be extracted with ether and water and then crystallized. There are, of course, details of manufacture requiring attention but the method is simple and there is no difficulty in obtaining a pure product. In view of this fact it is surprising that there should have been so much trouble in getting from American sources a haematoxylin comparable with the one commonly in use at the time the foreign supply was cut off by the war. The miserable black logwood extracts that were then sold as haematoxylin were an abomination to microscopists. Failing to secure any decent material on the market, I undertook to make haematoxylin from the logwood chips and found no difficulty in doing so. Later, there appeared for sale by a number of dealers a product called "white crystals" and this has proved to be generally satisfactory. It now appears that the source of practically all this supply is the firm of McAndrews & Forbes Company, of Camden, N. J. A description of the method employed by them for the preparation of haematoxylin from logwood extract appeared in the *Journal of Industrial and Engineering Chemistry* of February, 1920.

Complaints having come to the Committee on the Standardization of Biological Stains that solutions of the white crystals did not keep well, the chairman, Dr. Conn, asked me to investigate the matter. Accordingly, with the help of Dr. Carothers, I undertook a study of a series of products which had been submitted for trial. Later I got directly in touch with the manufacturers and from them received samples of the material at different stages of manufacture and under different treatment.

As a result of all this it was learned that the "white crystals" produced to meet the demand for something different from the black crystals (?) previously on the market, owe their absence of color to the use of sulphur dioxide. In some way this agent renders the haematoxylin less stable and solutions made up with heat become very dark and stain a rusty brown without selectivity. Apparently also it is responsible for the poor keeping quality of solutions. The manufacturers, upon learning these facts, discontinued the use of sulphur and now market their product as crystals of a light brown color, similar to those of the imported substance. It is now possible, therefore, to secure in this country an entirely satisfactory haematoxylin, which can be used for the finest cytological work by the iron-haematoxylin method. This has been compared with recently imported haematoxylin and found in every way as satisfactory.

In the investigation of the various haematoxylins submitted a number of facts appeared which are of value in cytological technique. It was found, for example, that the color of a given sample might be entirely satisfactory and yet its selectivity be almost entirely lacking. Again one sample might produce a hard, sharp, vigorous coloration while another was weak and indefinite. Of course, it is possible to modify, or even reverse, the staining reaction, as I have previously announced, by incomplete removal of Flemming's fluid, but in the present series of experiments this factor did not enter.

Just what is the cause of these variations in staining reaction is not clear, but having noted certain peculiarities in the operation of the cruder samples and having observed the somewhat turbid character of their solutions, I added a small quantity of lead acetate to them. The result was to greatly improve the vigor and selectivity of the stain. I am inclined, therefore, to recommend the following procedure in cases where satisfactory results are not obtained by the iron-haematoxylin method: To 100 cc of one half per cent. haematoxylin add about three drops of a saturated solution of lead acetate and shake. The solution will become very dark but upon standing for a number of hours a fine black precipitate will form. When this is filtered out a bright clear liquid will remain. This should then give a satisfactory stain.

A good object upon which to try out the stain is a root tip section. Here it is desirable to have the chromatin stain a good vigorous black and yet without such density as to obscure the finer internal structure of prophase and telophase stages. The nucleolus at the same time should stain like the chromatin and should not, on the one hand bleach out entirely or on the other remain a dense black. All outlines should be clear and sharp in the nuclear structures without gradation into the ground substance. The cytoplasm should be light gray in color and clear and transparent. These are conditions which manifest themselves in Podophyllum root tips after fixation in Flemming's strong fluid.

C. E. MCCLUNG

UNIVERSITY OF PENNSYLVANIA

FISHES FALLEN FROM THE SKY

THE ichthyologist of the American Museum of Natural History, Dr. E. W. Gudger, in his most interesting paper "Rains of Fishes,"[1] has grouped together many astonishing accounts of fishes falling from the sky. I wish to add some data on my own experiences with this subject.

The Yukaghir, living on the Siberian tundra between the Kolyma and Alaseya rivers, told me that the sky, regarded by them as a beneficent deity, to supply men with food flings fishes to the earth. When fish appear in the lakes in great numbers, the Yukaghir say that they have fallen from heaven. They know well enough that fish develop from spawning, but they say that fish originally had been and continue to be sent by the deity. When asked how they knew fish fall from the sky, the Yukaghir asserted that they often found living pike (*Esox lucius*) and a river species of salmonidae, called cheer (*Coregonus nasutus*), in dry places. Evidently, said the Yukaghir, it followed that these fish in falling from heaven failed to reach the water. I explain this phenomenon in the following way: The majority of polar lakes are connected by small rivulets which the fish follow when passing from one lake to another for spawning. In the course of the passage the fish jump over obstructions formed by stones and grass hillocks. In the summer when the rivulets run completely dry in places, the migrating fish may find themselves caught on dry land.

I wish to refer to another phenomenon connected with the above belief of the Yukaghir. When some tundra lakes during a rough and snowless winter freeze to the bottom, the fish die and in the spring rise to the surface. But the lake-fauna recovers soon and new fishes appear. Without any doubt, this phenomenon may be explained by what is known as anabiosis: some frozen fishes may come to life again after thawing, or by the appearance of new fishes from other lakes through the connecting rivulets. But the Yukaghir in such cases said that the new fishes fell from the sky.

I wish to mention here another phenomenon of this kind, although it has entirely different origin and causation. While spending the winter of 1909–1910 on Umnak Island of the Aleutian Chain I experienced volcanic shocks several times. Once I was awakened in the night by a particular subterranean noise and tremor of the earth; the floor of my log cabin shook. In the morning the shore was covered with a layer of stunned fish, sea-urchins and shell-fish about two feet high and two feet wide, but in several days these were carried to the neighboring hills and eaten by gulls and ravens. The presence of shells of echini and mollusca on the hills may lead some traveler to the deceptive idea that the hills were formerly the sea bottom.

WALDEMAR JOCHELSON

NEW YORK, N. Y.

[1] *Natural History*, Journal of the A. M. of N. H., Vol. XXI, Nov.–Dec., 1921, No. 6, p. 637.

EINSTEIN AND SOLDNER

IN your issue of August 31 (1923), pp. 161–163, Dr. Robert Trumpler has explained Soldner's method of calculating the deflection of light passing near the sun and has called attention to the error in Soldner's work which had been pointed out by Lenard. In accordance with the Newtonian theory of gravitation a particle moving from infinity with the velocity of light c describes a hyperbola and the angle between the asymptotes is the deflection. From this theory it follows that the velocity *increases* as the particle approaches the sun; in fact, $v = c(1 + \gamma M/c^2 r$ approximately.

In his 1911 paper Einstein discussed the effect of a Newtonian gravitational field on a clock and came to the conclusion that a clock is slowed down as it approaches matter; in particular a clock at the distance r from the gravitating mass goes $(1 - \gamma M/c^2 r)$ times as fast as at infinity. If it is assumed further that the velocity of light is c at any point when measured in a suitable local coordinate system, then its velocity as measured in a natural system is $c\,(1 - \gamma M/c^2 r)$. Hence the velocity of the light from a star *decreases* as it approaches the sun. Einstein then makes use of Huyghens's principle to determine the deflection. Thus he uses the wave-theory of light, and not the corpuscular theory, as some of his critics contend. Einstein's 1911 theory is Newtonian in that he uses the Newtonian gravitational potential, but it is not Newtonian in the sense of Soldner. In his general theory of relativity the velocity is $c\,(1 - 2\gamma M/c^2 r)$, which accounts for double the deflection previously found. But here again the velocity decreases as the light approaches the sun and Einstein uses the wave-theory of light to calculate the deflection.

Dr. Trumpler called attention to the fact that Einstein used a different method from Soldner, but he overlooked the essential distinction between the two methods as is shown by his statement: "The fundamental assumptions on which Soldner's work is based are equivalent, as far as the present problem is concerned, to those of Einstein's 1911 paper, and Einstein's 1911 results must be and are in agreement with those of Soldner (after correcting Soldner's mistake)." They are so far as the amount of the deflection is concerned, but not otherwise. Consequently, Captain See's criticism published in SCIENCE for November 9 (1923), p. 372, is not valid, when the

distinction between the two methods is fully appreciated.

L. P. EISENHART

PRINCETON UNIVERSITY

QUOTATIONS

CONFIRMATION OF THE EINSTEIN THEORY

EINSTEIN'S theory of relativity has aroused such widespread attention that it may interest your readers to repeat in your columns an announcement which has already appeared in the scientific press.

It will be remembered that Einstein suggested three crucial tests of his theory, which experience could make. The first concerned the movement of the planet Mercury, and had already been satisfactorily made. The second could be made at a total eclipse of the sun, and concerned the bending of light rays from a star; at the eclipse of 1919 the English astronomers obtained a clear answer in favor of the theory, very satisfactorily confirmed by the American observers in 1922. The third test concerned the apparent length of the waves of light as affected by gravitation.

In this third case experiment gave at first very dubious results, some observers even declaring against the effect suggested by the theory. Moreover, some mathematicians challenged the correctness of the inference from the theory, though Einstein never wavered in his declaration that it was a necessary inference. These clouds which have hung about the third test have now been dissipated. Mr. C. E. St. John, of Mount Wilson, who had thrown the gravest doubts on the experimental facts, has now come round definitely in favor of the Einstein result. He makes his own announcement in SCIENCE for September 28. Mr. Evershed (who has just retired from a long and able directorship of the Kodaikanal Observatory in Southern India) had already given very strong evidence in favor of Einstein, but the conversion of Mr. St. John is of obvious importance, and the joint testimony of these former opponents leaves the matter now in no reasonable doubt.

It is satisfactory to review the part that English astronomers have played in the establishment of this development of Newton's great law of gravitation. The Astronomer Royal pointed out, even during the war, the great opportunity of 1919, and English observers hastened to utilize it with success. Professor Eddington was one of the observers, and has played a leading part in the exposition of the new theory. Mr. Evershed stood for some time almost alone as the champion of the third test. We need not underestimate the value of the confirmation by American observers in both cases; but it seems due to those mentioned to remember the courage which secured their priority.—*H. H. Turner, University Observatory, Oxford, in the London Times.*

SCIENTIFIC BOOKS

Fortschritte der Geologie und Paleontologie. Heft 2. *Die Familien der Reptilien.* By FRANZ BARON NOPSCA. 210 pages and VI plates. Gebrüder Borntrager, Berlin, 1923.

MOST of the leaders in vertebrate paleontology have given us their ideas of the proper classification of the reptilia, and this paper adds a valued name to the list. There is no one whose knowledge of the reptilia, living and extinct, is more comprehensive than Dr. Nopsca, and no one whose opinion is more significant. In his paper Dr. Nopsca has brought together twelve suggested classifications which have been offered since 1890 over the names of such men as Cope, Zittel, Fürbringer, Huene, Broom, Watson and others, and to this list he adds his own as the thirteenth. A glance through these classifications illustrates clearly the difficulties inherent in the task; they show many and radical differences of opinion, both in the composition of the various groups and the relative taxonomic rank assigned to each, such as Super-Orders, Orders and Sub-Orders. Certain groups have attained a relative stability as to their content, as the Cotylosauria, Ichthyopterygia, Testudinata, Sauropterygia, Lacertilia, Crocodilia, Dinosauria and Pterosauria, but the taxonomic position is still uncertain and for some, even the content is still in dispute—witness the growing conviction that the Dinosauria is a composite rather than a coherent group, and the recent suggestion that the Pterosauria be divided.

The cause of this difference of opinion is largely due to the fact that each author has considered a different character or group of characters as of capital importance. Happily, classification is based to-day entirely upon genetic relationships, but the material at the disposal of the paleontologist is still too limited to permit a selection of the characters which reveal most accurately this genetic relationship; the personal factor is still prominent in each suggested classification. The most crying need in systematic paleontology to-day is a determination of what structures are fundamental in the development of any phylum and the direction of their evolutionary changes, as opposed to the secondary adaptive changes. Only when these have been determined and generally accepted will we have a consistent and uniform classification; until then each author must produce a mosaic of relationships based upon his individual opinion of the relative importance of certain characters. In the opinion of the author of this review a correct and generally acceptable classification will not be attained until the emphasis is shifted from the form to the

function; when all the factors which have determined the bodily structure have been determined and evaluated.

It is interesting to note that Dr. Nopsca's avowed method of procedure is to work from the end result back to the beginning, rather than from the simple, comprehensive type towards the highly specialized. Neither method can be entirely successful until far more material is collected and studied, but it may be seriously questioned whether a start with the primitive forms does not make it far more possible to determine fundamental structures and changes than to start with the most aberrant forms where the lines of genetic relationship are obscured by secondary adaptations, possible parallelisms, convergences and polyphyletism.

Dr. Nopsca offers us a careful comparative analysis of the structure of 25 forms which he considers the most aberrant or specialized; from this study he suggests a classification which contains ten Super-Orders, one of which is new, the Dranitesauria; 21 Orders, of which two, the Rhizosauria and Chainosauria, are new; and a correspondingly large number of sub-Orders and Families. In this arrangement we have a clear illustration of the unfortunate lack of uniformity; other authors are best satisfied to express conceived relationships by groups of lesser rank. To the experienced worker such shifts in the rank of groups means little, but to the student, to whom an Order is a positive concept, the matter is most confusing.

As is natural, Dr. Nopsca's opinions lead to a new mosaic of relationships, and, in the opinion of some, to strange fellowships among the reptilia. We find the Thallatosauria grouped with the Pelycosauria, the Mesosauria with the Ichthyosauria and the Family Caseidae next to the Edaphosauridae.

As a part of his paper, Dr. Nopsca gives us a valuable review of the known reptilian footprints and more or less closely allocates each to distinct families or even genera. This discussion is most helpful and illuminating, but one hesitates to concede the accuracy of some of his suggestions, as when animals known only from distant regions are suggested as the makers of footprints found in England.

It is an interesting commentary on the breadth of the work in modern morphology that Dr. Nopsca speculates upon the effect of vitamines and hormones upon the development of Paleozoic and Mesozoic reptiles. This is but one of many evidences that the mere comparison of parts is no longer sufficient to him who would determine the genetic relationships which alone can form the basis of a true phylogeny. Physiology, environment, function—all these must be considered to have their share and must be read in the shape of the bones and in the sediments which reveal the environment during life of the animal remains there buried.

Dr. Nopsca's work is a most valuable contribution to the history of the reptilia, filled with information and abounding in suggestive interpretations.

E. C. CASE
UNIVERSITY OF MICHIGAN

SPECIAL ARTICLES

THE EFFECT OF FORMALDEHYDE UPON THE VITAMIN CONTENT OF MILK

THE desirability of a wholesome milk supply for every household is, of course, granted by every one. Common experience and scientific investigation have both shown the unquestioned value of milk in the diet, particularly for the child. The great problem to be solved, however, is that of bringing the milk from the producing dairy to the consumer within such time and under such conditions as to prevent harmful changes in the milk before its utilization. To meet the situation various methods have been proposed and carried out, the ideal one being the cleanliness and icing method that results in "certified" milk. Unfortunately, the necessary expense of such a method makes the product cost so much that it is only comparatively few who are able to use such a product for the family supply. The more common method is that of pasteurization, and its value as a method of insuring a useful milk for home consumption is not to be questioned.

However, investigators and dieticians are fairly well agreed that the process of pasteurizing is not without its drawbacks. It is conceded that the process results in the destruction of at least one vitamin to a very large extent, and most workers feel that the other vitamins also are depleted. This would, perhaps, not be a serious drawback if the milk were to be used by adults using an otherwise satisfactory mixed diet, but when the milk is to be used as the sole article of the baby's diet then the question does become an acute one. Usually, such a diet is supplemented by fruit juices or other similar sources of vitamins under such conditions. Nevertheless, thousands of babies, whose parents never heard of vitamins, are given the insufficient pasteurized milk with disastrous results.

Knowing the preservative value of formaldehyde, the following work was carried out within the past year to determine its possible usefulness in preventing undesirable changes in milk. T. M. Price,[2] working

[1] From the Department of Physiology, Ohio State University.

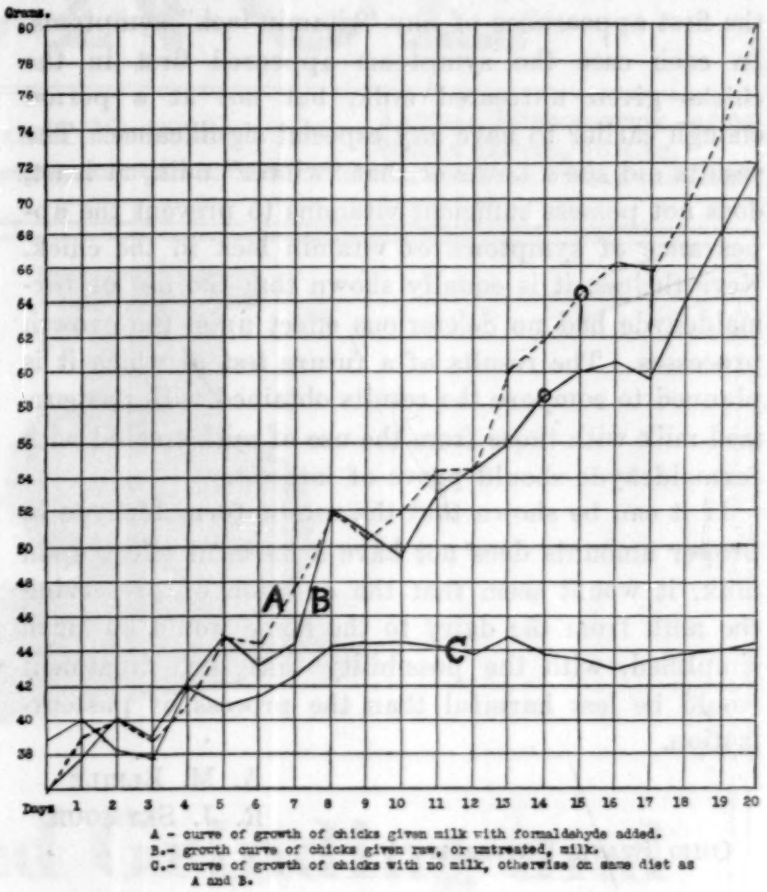
[2] T. M. Price, Centr. Bakt. Par., Abt. 2, 1905, 14, 65–75.

in the Biochemic Division of the U. S. Department of Agriculture, showed by a long series of experiments upon calves that formaldehyde, in proper amount to prevent souring of milk, had no ill effects whatever. Some of Price's conclusions were as follows:

"Formaldehyde in the proportion of 1:20,000 preserves the milk for 48 hours; used in twice that strength (or 1:10,000) it does not interfere with the digestion of milk when fed to calves." "Upon feeding calves through a long period with milk preserved with formaldehyde the calves remained healthy and gained in weight." "Much stronger solutions of formaldehyde (1:2,500) have no effect upon the activity of fresh enzymes—rennet, pepsin, pancreatin—in vitro."

The conclusions of Price are confirmed by the work done by Rideal and Fullerton,[3] although other workers have declared that formaldehyde does affect the coagulation of milk protein. However, those investigators finding such possibly harmful effects have universally used solutions of formaldehyde of much greater concentration than would be necessary to prevent milk souring—usually amounts varying from 1:25 to 1:2,000 being employed. At the time of Price's work vitamins were as yet unknown, and so it seemed possible that the effects of formaldehyde upon the vitamins of milk might be such as to preclude its usefulness as a preservative. An effort to determine the effects, if any, resulted in the following experiments.

Four years ago Seymour and Durrant[4] pointed out the utility of chicks as experimental animals in determinations of vitamin deficiency. During the past year Emmett and Peacock[5] confirmed these findings while using considerably larger numbers of chicks. Both sets of experiments showed that baby chicks are particularly susceptible to a lack of vitamins and thus lend themselves admirably to the determination of whether any particular diet is lacking in these essential substances. In the present experiments baby chicks were fed a diet practically free from vitamins (highly milled cornmeal baked into cakes, rice flour cakes, unleavened white flour cakes, etc.) with free access to grit, shell, charcoal, etc. Such a diet gives early evidences of lack of vitamins and results in a growth curve similar to "C" as shown upon the chart. Added to this diet in the present tests, however, was milk, both ordinary raw milk and milk treated with sufficient formaldehyde (1:20,000) to prevent souring at room temperature for at least 24 hours. The effect of the addition of the milk is readily seen by comparing growth curves "A" and "B" with the curve of growth when milk was lacking.



A - curve of growth of chicks given milk with formaldehyde added.
B.- growth curve of chicks given raw, or untreated, milk.
C.- curve of growth of chicks with no milk, otherwise on same diet as A and B.

A—Curve of growth of chicks given milk with formaldehyde added.
B—Growth curve of chicks given raw, or untreated, milk.
C—Curve of growth of chicks with no milk, otherwise on same diet as A and B.

The chicks were divided into two groups of equal number and approximately equal weights. Each group had identical food, had access to the same brooder and were under the same conditions as to light, heat, etc. The sole source of liquid for the chicks was milk. Group B was given raw milk just as it came from the dairy, while Group A was given only milk that had formaldehyde added in the amount mentioned. The milk was "winter" milk, notably low in vitamin content, and hence, if the formaldehyde had any destructive action on the vitamins it should have been all the more readily noted, particularly when fed to the very susceptible chick. Two separate tests were run, one in March, 1922, and the second in November. The results of both were practically identical. The growth curves shown are those obtained in March, that of November differing only in that the chicks fed milk that had been treated with formaldehyde outstripped the other chicks to an even

[3] Rideal & Foulerton, Exp. Sta. Rec., 1900, 11, 582 (also, Rideal, Lancet, 1900, I, 228–230).

[4] Seymour & Durrant, *Ohio Jour. of Sci.*, 1919, XIX, No. 8, 509–512 (also, SCIENCE, N. S., XLIX, No. 1271, 448).

[5] Emmett & Peacock, *Jour. Biol. Chem.*, 50, Feb., 1922 (Proc. Amer. Soc. Biol. Chem.).